CLIMATE ACTION PATHWAY

OCEANS & COASTAL ZONES

Vision and Summary

2021

VISION

A HEALTHY AND PRODUCTIVE OCEAN FOR A RESILIENT AND NET-ZERO FUTURE

It is 2050 and the Ocean is thriving and abundant. All fish[1] stocks have recovered and are fished sustainably, coastal and marine ecosystems are restored, and a massive loss of coastal and open ocean ecosystems (coral reefs, mangroves, seagrass, deep seas, etc.) was reversed. We dramatically slowed the pace of ocean warming, acidification and deoxygenation by limiting global warming to 1.5 ^{o}C. The ocean and sustainable ocean-based activities have been leveraged to provide employment, food and energy security for the world's growing population and achieve a resilient, net-zero world. These activities have made a significant contribution to successfully addressing four global emergencies: climate change, biodiversity loss, pollution and the human health pandemic that humankind faced in the 2020s (COVID-19). Crucially, coastal communities have been protected from and have been provided the means to adapt to the worst consequences of climate change.

Society at large recognized the **inherent value of the Ocean**. A vibrant, equitable and sustainable ocean economy has spurred inclusive well-being around the world. We have succeeded in adopting a holistic and sustainable approach where ocean production and protection go hand-in-hand. Ocean industries underwent an innovative transformation to become net-zero and contribute to reverse biodiversity loss. Governments are taking an integrated co-design approach to ocean science and management, positively balancing sustainable, climate-resilient production and conservation. The Ocean is **100 per cent sustainably managed,** and the objective of protecting 30 per cent of the Ocean by 2030 has been met[2] and even exceeded. Marine protected areas (MPAs) are effective, adaptive and fully enforced around the world.[3]

The twenty-sixth session of the Conference of the Parties (COP 26) has been a turning point in recognizing the role of the Ocean in regulating the climate and therefore delivering on the 1.5 C target, with successful COPs consistently taking action for the Ocean. **Ocean-based climate solutions**, building on scientific information, contributed greatly to the enhancement of governments' nationally determined contributions (NDCs), helping the world to meet the net-zero target without adverse impacts on biodiversity and marine ecosystem functioning.

Ocean renewable energy is now a major source of clean energy. Sustainably planned and managed offshore wind is scaled up in every region of the world. Other technologies such as wave and tidal energy are reliable contributors to the clean energy market. Offshore wind development and other maritime activities have been greatly supported by robust maritime/marine spatial planning (MSP)[4] and investments in grid and transmission infrastructure, in turn protecting biodiversity, in harmonious co-existence with other ocean users.

The aquatic food industry adopted sustainable and climate-smart practices. The supply chain and consumption patterns fostered responsible consumption, improved diets and minimized loss and waste.

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[1] Unless otherwise specified, throughout this document, the term "fish" indicates fish, crustaceans, molluscs and other aquatic animals, but excludes aquatic mammals, reptiles, seaweeds and other aquatic plants.

[2] https://sdgs.un.org/goals/goal14.

[3] https://www.cbd.int/marine/.

[4] https://www.mspglobal2030.org/msp-roadmap/.

The industry has sustainably increased its production to feed a population of 10 billion. The aquaculture industry has grown significantly and produces food sustainably, supported by novel or zero-fish feeds, diversification of farmed species, increased non-food aquaculture, the adoption of new techniques to limit impact on local ecosystems and zero-emission transport to the markets. The fisheries industry is thriving due to climate-adaptive and sustainable management. Small-scale fishing and aquaculture producers have successfully adapted their practices and livelihoods to new coastal and marine conditions, while delivering healthy seafood to local, regional and global markets. Aquatic food supported a major shift in food systems by providing a low-carbon source of proteins (compared to land-based proteins) and essential micronutrients. Comprehensive traceability systems and increased transparency in the aquatic food value chain encourage consumers to eat recommended amounts of seafood, which is now recognized as a critical component of the low-carbon emission food system.

Ocean transport successfully made its transition to zero-emission vessels while scaling up to support the growing world economy. New and dynamic transportation routes – integrated into government ocean management plans – have been designed to minimize negative impacts on marine life.

Ports (including fishing ports) enhance sustainable blue activities. **Coastal tourism** and recreational activities are planned sustainably.

In finance, the ocean-related climate negative and positive impacts are factored into investment and banking agreements in a transparent manner. Ocean and coastal zones' ecosystem values and natural capital are anchored into policy and financial frameworks and decisions.

A sustainable net-zero ocean economy supports equitable access to ocean resources, benefiting women and men equally. **Scientific knowledge has substantially increased,** and ocean science addressing the ocean–climate nexus is further progressing thanks to adequate funding, with growing technical capacity on ocean science in developing countries, increased access to technology and enhanced global systems for data sharing, and the engagement of traditional and indigenous knowledge. Ocean science is informing regulatory policy, investment decisions and business actions.

SYSTEM TRANSFORMATION SUMMARY

The ocean – covering 71 percent of the Earth's surface – plays a fundamental role in regulating global temperatures. Not only does the ocean absorb 93 per cent of the additional heat from rising anthropogenic carbon dioxide (CO_2) emissions, it also absorbs approximately 25 to 30 per cent of anthropogenic CO_2 emissions that would otherwise remain in the atmosphere and increase global warming. The ocean also produces around 50 per cent of the oxygen on the planet through the photosynthetic activity of marine plants and algae. However, **being vast does not mean being resilient to pressures**. The ocean and its organisms, habitats, ecosystems, resources and the key services it provides are under heightened pressure from multiple threats. First on the list are climate change-driven stressors, which are exacerbated by other human-induced pressure such as pollution, eutrophication, habitat destruction and unsustainable use of aquatic living resources.

The most recent Intergovernmental Panel on Climate Change (IPCC) report, the Special Report on the Ocean and Cryosphere in a Changing Climate, highlights the dire impacts on the ocean that are already underway (including ocean warming, acidification and deoxygenation) and provides a sense of even greater urgency to aggressively reduce greenhouse gas (GHG) emissions. A 100–150 per cent rise in ocean acidity is projected by 2100, affecting half of all marine life.

The impacts of climate change on the ocean are also putting at risk 40 per cent of the world's population who live in coastal areas and/or rely on the ocean for their livelihood and food security. These communities are already bearing the consequences of rising sea levels, eroding coastlines, more frequent and more severe extreme weather events, increased salinization of inland areas, as well as changing environmental conditions that affect the fishery resources. This is particularly true in developing countries where coastal communities are recognized to be among the most vulnerable to climate change.

At the same time, commercial and technological developments are drawing more attention to the ocean and its resources as solutions to combat climate change. **The ocean is increasingly vital to securing sustainable and reliable access to climate-resilient, low-carbon food, energy and transportation for a growing world population**.

The Organisation for Economic Co-operation and Development[5] has projected that growth of the ocean economy will significantly outpace increases in global terrestrial gross domestic product in the coming decades. Research also shows that ocean-based mitigation options could help to reduce the emissions gap by up to 21 per cent on a 1.5 °C pathway by 2050.[6]

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[5] https://www.oecd.org/environment/the-ocean-economy-in-2030-9789264251724-en.htm.
[6] Hoegh-Guldberg. O., et al. 2019. "The Ocean as a Solution to Climate Change: Five Opportunities for Action." Report. Washington, DC: World Resources Institute. Available online at http://www.oceanpanel.org/climate.

Ocean-based mitigation and adaptation options do not feature as prominently as they could in NDCs or long-term low-GHG emission development strategies under the Paris Agreement.[7] The growing scientific understanding from ocean research, observations and modelling needs to play a central role in the formulation of global emission reduction targets.

There is a **series of key enablers** for scaling up ocean-based climate solutions including:

i) Wide-ranging political and societal recognition of the vital role the ocean plays in both climate regulation, adaptation and mitigation;

ii) A subsequently sustainable and equitable well-managed ocean, aligned with climate goals and biodiversity targets, to provide the necessary space, regulatory frameworks and predictability for sustainable ocean activities;

iii) Increased public and private investments, including blended finance mechanisms in particular, to support developing countries to build strong sustainable blue economy strategies and adapt to climate change;

At the same time, adaptation measures need to be identified and implemented urgently in coastal areas, as they are at the forefront of changing ocean conditions.

In order to achieve this system transformation for the ocean and coastal zones, the following change levers must be activated:

1) Nature-Based Solutions (NBS);
2) Aquatic Food production;
3) Zero-emission shipping;
4) Ocean Renewable Energy.

Additional information about the change levers can be found in the Ocean and Coastal Zones Action Table. It should also be noted that many cross-cutting actions and synergies exist with the Land Use, Transport, Water, and Resilience Climate Action Pathways, particularly due to the interactions between land use and freshwater, coastal and marine ecosystems as well as the interdependencies among land and sea systems.

[7] Northrop, E., S. Rufo, G. Taraska, L. Schindler Murray, E. Pidgeon, E. Landis, E. Cerny-Chipman, A. Laura, D. Herr, L. Suatoni, G. Miles, T. Fitzgerald, J.D. McBee, T. Thomas, S. Cooley, A. Merwin, A. Steinsmeier, D. Rader, and M. Finch. 2020. "Enhancing Nationally Determined Contributions: Opportunities for Ocean-Based Climate Action" Working Paper. Washington, DC: World Resources Institute. Available online at www.wri.org/publication/enhancing-nationally-determined-contributions-opportunities-for-oceanbasedclimate-action.

1) Nature-Based Solutions

Nature-Based Solutions provided by coastal ecosystems (such as mangroves, tidal marshes, coral reefs, sand dunes, seagrass beds and seaweed) hold **great potential for mitigation and adaptation to climate change**. According to a 2019 High Level Panel for a Sustainable Ocean Economy report,[8] protecting and restoring three coastal blue carbon ecosystems (seagrass, tidal marshes and mangroves) globally, alongside seaweed farming, could reduce emissions by as much as 1.4 billion tonnes of carbon dioxide equivalent annually by 2050. Coastal ecosystems in their entirety are also critical **'natural infrastructure'** for climate change adaptation and resilience. Restored ocean and riparian ecosystems can help mitigate the impact of storms and sea-level rise, thus saving lives and livelihoods, and would reduce the economic costs of damage and recovery.

National governments should aim to include more NBS and especially coastal blue carbon ecosystems in **NDCs** for both their mitigation and adaptation components in order to achieve policy recognition, and most importantly, pave the way for action and broad-scale finance mobilization. Governments should also protect 30 per cent of the ocean by 2030, prioritizing areas for their high climate, food and biodiversity benefits. Governments can contribute to the restoration of marine ecosystems by effectively implementing climate-smart MPAs and conducting processes such as MSP and integrated coastal zone management.

Companies should – at the very least – eliminate activities in their supply chains that contribute to the destruction of marine and coastal ecosystems and identify actions to protect and restore ocean ecosystems.

Ocean ecosystems can also be included as compensation/offsetting measure while companies transition toward a state of net-zero emissions. However, they do not replace the need to reduce value chain emissions in line with science. Any offsets used by companies are optional and additional to emission reduction targets. Offsetting should prioritize interventions with strong co-benefits and that contribute to achieving other social and biodiversity goals.

As shown in the IPCC Special Report on the Ocean and the Cryosphere in a Changing Climate, **more concrete, evidence-based targets are needed**, in particular in nations holding a large percentage of the world's coastal blue carbon ecosystems. International initiatives such as the United Nations Decade on Ecosystem Restoration (2021–2030) and the United Nations Decade on Ocean Science for Sustainable Development (2021–2030) can help to provide data and information on required actions by each type of actor and how to implement these. The inclusion of local communities, the equal participation of all genders, as well as the incorporation of indigenous and traditional knowledge are essential to achieve the effective implementation of sustainable nature-based approaches to conservation, protection and restoration of coastal and marine ecosystems.

[8] Hoegh-Guldberg. O., et al. 2019. ''The Ocean as a Solution to Climate Change: Five Opportunities for Action.'' Report. Washington, DC: World Resources Institute. Available online at http://www.oceanpanel.org/climate.

2) Aquatic food production

Globally, aquatic food systems make **substantial contributions to food and nutrition security** and the livelihoods of billions of people. According to the Food and Agriculture Organization of the United Nations (FAO), fish provide more than 3.3 billion people with at least 20 per cent of their average per capita intake of animal protein (FAO, 2020) and are a key source of essential micronutrients such as vitamin B12 and omega-3 fatty acids. Fish consumption has been growing at twice the rate of population growth, outpacing other animal protein consumption, and is projected to become a bigger portion of future diets.

Changes in ocean temperature, acidification, oxygenation and ocean circulation cause **significant, geographically differential,** favourable, unfavourable and neutral **impacts on the distribution and abundance of fish stocks**. Sea level rise and increasing storm events threaten coastal ecosystems and aquatic food infrastructure. These impacts of climate change on aquatic food systems will affect individuals and communities that depend on the sector for their livelihoods: an estimated 10 per cent of the world's population, primarily located in developing countries.

Fast-growing aquaculture represent an opportunity to increase the production of sea-based proteins and can provide alternative livelihoods for fishers and fish workers. At the same time, mismanagement of aquaculture might pose additional stress on marine environments through pollution and habitat destruction, affecting marine biodiversity and marine ecosystems.

Adaptation and mitigation actions taken throughout aquatic food systems will need to be scaled up to increase the climate resilience of both the **production** and **consumption** streams, reduce **food loss and waste**, and transform all **supply chains,** making them transparent and sustainable.

a) Adaptation and resilience

Some challenges associated with climate change impacts on fisheries are **shared by local communities and industrial fishing fleets alike**. Among these is an increasingly unpredictable ocean in which the distribution and abundance of fish populations may rapidly change.

Key tools for adaptation therefore include: establishing management agreements with built-in triggers for pre-agreed actions in the case of unexpected changes; setting climate-appropriate goals and harvest control rules for species and species groups; enacting policies to address shifts in fish distributions; adopting measures to strengthen resilience (e.g. risk transfer mechanisms such as social protection and insurance, climate risk-proofing of grey infrastructure along the aquatic food value chain such as harbors, landing and processing sites); and adopting adaptive, dynamic and ecosystem-based approaches to management.[9] The FAO Adaptation Toolbox consolidates available adaptation tools and strategies for capture fisheries and aquaculture.

[9] Northrop et al. 2020. "Enhancing Nationally Determined Contributions: Opportunities for Ocean-Based Climate Action" Working Paper. Washington, DC: World Resources Institute. Available online at www.wri.org/publication/enhancing-nationally-determined-contributions-opportunities-for-ocean-basedclimate-action.

Countries need also to adopt **adaptive monitoring mechanisms** (e.g. agro-climatic and disaster risk information systems, early warning systems) and **adaptive climate and disaster risk governance** to provide a solid foundation for sustainable aquatic food production.

In addition, it will be indispensable to increase investments into ocean research, observation, related modelling and scenario-building to inform responsible management decisions. In addition, efforts should be made to maintain the diversity present in the aquatic food sector – including the essential role of small-scale actors – as a way of promoting resilience. Ultimately, embracing a **precautionary approach** to fisheries management, rather than pushing the limits of maximization and optimization, will support adaptive management.

In aquaculture, vulnerability reduction depends on broader adaptation measures beyond the aquaculture sector, and there is a strong need to integrate aquaculture management and adaptation into watershed and coastal zone management. Ultimately, it is at the farm level where vulnerability reduction efforts converge. Specific measures to reduce aquaculture vulnerability in accordance with the ecosystem approach to aquaculture include improved management and spatial planning of farms and choice of farmed species that take into account climate-related risks and improved environmental monitoring systems involving users.

b) Mitigation

When it comes to **mitigation**, aquatic food derived from sustainable fisheries and aquaculture is known to have one of the lowest carbon footprints among all the food commodities,[10] but there are significant opportunities for enforced decarbonisation along the value chains of aquatic food systems.

Changes of fuel sources in vessels and technological advances in production techniques can reduce the emissions associated with seafood from both wild-caught fisheries and ocean-based aquaculture. In aquaculture there are also opportunities to reduce GHG emissions by improving technological efficiency, reducing reliance on fossil fuel, replacing fish-based feed ingredients, producing closer to the final market, and improving feed conversion rates. Combining these approaches would result in a reduction of 21 percent in CO_2 emissions per tonne of fish produced.

In addition, there is a need to **strengthen and standardize methodologies for life cycle emissions assessments** (including scope 3) of the aquatic food industry for transparently assessing and reducing its GHG emissions.

Finally, policy reform and sustainable management that leads to improved fish stocks – such as science-based catch targets, secure tenure and the elimination of inefficient fuel subsidies – can have mitigation benefits by reducing fishing effort and fuel use (Costello et al., 2016; Barange et al., 2018).[11]

[10] Fisheries and aquaculture should be operated in a sustainable manner. This requirement is underlined in various international instruments, including the 2030 Agenda for Sustainable Development (e.g. Sustainable Development Goal target 14.4), the FAO Code of Conduct for Responsible Fisheries, the FAO Declaration for Sustainable Fisheries and Aquaculture, and the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication. Under this requirement, for instance, States and users of living aquatic resources are encouraged to eliminate destructive fishing practices and promote the development and application of selective and environmentally safe fishing gear and practices in order to conserve the fish population structure and aquatic ecosystems and protect fish quality.

As the carbon footprint of aquatic food derived from sustainable fisheries and aquaculture is lower compared to other animal production systems, the sector represents a **consumers' solution** to shift from GHG-intensive diets to **climate-friendly and sustainable diets** that include more GHG-friendly aquatic food options if the industry transitions to sustainable production systems (i.e. systems that produce more, are resilient to the impacts of climate change and deliver more socioeconomic benefits with fewer environmental consequences).

The potential is high. Recent scientific research predicts that food from the sea, if managed well, could increase by 21–44 million tonnes by 2050, a 36–74 per cent increase compared to current yields. This represents 12–25 per cent of the estimated increase in all meat needed to feed 9.8 billion people by 2050 (Costello et al., 2020). Moreover, given that 35 per cent of the global harvest in capture fisheries and aquaculture is estimated to be either lost or wasted every year (FAO, 2020), **reducing food loss and waste** in aquatic food value chains represents good potential for adaptation and mitigation co-benefits.[12]

Consumers have a role to play in creating the demand conditions for seafood as a low-GHG source of protein. While consumers have an increasing demand for climate-friendly products with low GHG emissions, there is a need for strong public messaging on seafood to enable consumer choice and provide climate information. This could be achieved through either mandatory or voluntary eco-labelling schemes highlighting the GHG emissions of particular foods, similar to the Nutri-Score in the European Union or the Marine Stewardship Council certification.

Last but not least, it is important to recognize that for **many poor, rural populations in low-income food-deficit countries**, fish – particularly small fish and low-trophic species – may be the most accessible, affordable or preferred animal-source food contributing to the diversification of diets. However, the **current harvesting of aquatic foods is still highly unbalanced** and skewed towards high-trophic, less productive species rather than low-trophic species.

3) Shipping

In shipping, the lack of regulation and growing demand from customers as well as a fragmented industry, excess capacity and short investment horizons have led to the industry showing limited progress in decarbonisation so far. There is growing evidence that green ammonia produced from green hydrogen is the most feasible candidate for deep-sea shipping. However, the industry has yet to reach consensus on the decarbonisation pathway, and zero-carbon vessel technology is still in early stages of development.

By 2030, the industry should aim to achieve 5 per cent of propulsion energy from zero-carbon fuels for international shipping through a combination of container routes, niche vessel types (e.g. green ammonia and liquefied petroleum gas tankers) and niche routes (e.g. to Australia and Japan, which both plan for significant green ammonia production). For domestic shipping, the target should be 15 per cent, which can

[11] Northrop et al. 2020. "Enhancing Nationally Determined Contributions: Opportunities for Ocean-Based Climate Action" Working Paper. Washington, DC: World Resources Institute. Available online at www.wri.org/publication/enhancing-nationally-determined-contributions-opportunities-for-ocean-basedclimate-action.

[12] MacLeod et al (2020) Quantifying greenhouse gas emissions from global aquaculture https://www.nature.com/articles/s41598-020-68231-8.

be reached by 32 developed nations (which account for 50 per cent of domestic emissions), thus achieving 30 per cent decarbonisation. This level of zero-carbon fuel penetration is deemed to be the tipping point required to enable rapid adoption in the following years. A critical step on this path is to have industrial-scale zero-carbon ship demonstration projects implemented by 2025, with each project consisting of at least two ports with the necessary bunkering and refuelling infrastructure and at least one zero-carbon vessel in operation between the ports.

Further to transitioning to zero-emission energy, the shipping sector **must assess, reduce and avoid its negative impacts on marine biodiversity**. Shipping can have a direct impact on marine biodiversity as it can be a vector for non-indigenous and potentially invasive marine species, be a source of pollutants and noise, and collide with marine life and habitats.

More detailed information about shipping change levers to achieve zero-carbon shipping can be found in the Ocean and Coastal Zones Action Table and the Transport Action Table (p. 45).

4) Ocean renewable energy

Many technologies are currently being assessed for their ability **to harvest renewable energy from the ocean**. As of today, **bottom-fixed offshore wind** represents the largest part of the renewable energy production from the Ocean, with 35.3 gigawatts (GW) of installed capacity as of 2020,[13] due to its mature technology, scalability and rapid cost reduction over the last decade. Floating offshore wind is expected to reach wide scale commercialization closer to 2030. In addition, technologies to extract energy from waves and tides are progressing. Energy within the ocean can also be extracted from salinity and temperature gradients. Lastly, floating solar photovoltaic systems are beginning to emerge in marine environments.

More research is required to predict the future contribution of close-to-shore offshore wind sites to the global energy production, as numbers differ depending on the estimation approach. For example, the World Bank Group reports over 71,000 GW of offshore wind potential globally using current technology,[14] while the International Energy Agency (IEA) estimates that offshore wind could generate 18 times the world's current electricity demand.[15] The Ocean Renewable Energy Action Coalition (OREAC) envisioned that 1,400 GW of offshore wind is possible by 2050.[16]

In any case, the **potential of offshore wind is high**. This potential is supported by positive market conditions; over the past decade, cost per megawatt-hour (MWh) of installed capacity has fallen and the capacity factors (ratio between realized energy output and theoretical maximum output) for new installations are stronger than any other renewable energy,[17] especially in the floating sector. In addition, increased offshore wind targets in Europe, the United States of America and key markets in Asia such as Japan and the Republic of Korea are also triggering new scales of development. The expected

[13] GWEC – Global Wind Report 2021.
[14] https://datacatalog.worldbank.org/dataset/global-offshore-wind-technical-potential.
[15] https://www.iea.org/reports/offshore-wind-outlook-2019.
[16] OREAC – The power of our Ocean – December 2020.
[17] https://www.iea.org/data-and-statistics/charts/average-annual-capacity-factors-by-technology-2018.

commercialization and industrialization of floating wind in this decade can also accelerate the global energy transition.

During the energy transition, offshore wind represents a **business opportunity for a series of actors**. In particular, oil and gas companies, while shifting their portfolio to renewable energy, can use their expertise and knowledge for large-scale marine engineering and fabrication of offshore energy infrastructure. Under enabling policy conditions, offshore wind is also expected to play a key role in powering the production of green hydrogen.[18]

In the process of scaling up ocean energy production, especially to deeper waters and new sites, all **actors must consider their impacts on marine ecosystems**, such as noise pollution, heat production and other effects on the marine environment. Rigorous, proactive and concerted MSP and environmental impact assessments will be needed when establishing offshore infrastructure to minimize impacts on sensitive habitats, species and ecological processes and to ensure it is compatible with other ocean activities.

The potential is immense, but **governments must provide the enabling environment** to realize the development of offshore wind. This includes actions such as: developing the appropriate national vision, policy and legislation to procure and legislate ocean-based renewable energy; mapping and allocating sites for offshore wind development; and convening rigorous MSP and stakeholder consultation processes. As a broader step, governments can ensure that national targets and strategies (including NDCs) target specific increases of the share of ocean-based renewable energy in the national energy mix.

Governments should also consider various approaches for the **sustainable multi-use of sea space areas and infrastructures**, supported by ocean science and observation. New developments could combine two or more activities in windfarm areas such as seafood production, tourism, environmental restoration and facilitation of transit routes of smaller vessels. Multi-use infrastructures for renewable energy production and desalination combined with floating refuelling stations are current pioneering technologies in the energy transition.[19]

The new value chain of offshore renewable energy will require enhanced cooperation between governments, science and industries as well as cross-industry collaboration in the short- to medium-term on the way towards a net-zero 2050.

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[18] International Energy Agency (IEA), Net Zero by 2050 A Roadmap for the Global Energy Sector, 2021.
[19] https://www.h2020united.eu/images/Webinar_Reports/UNITED-2020-06-03-Webinar_PRESENTATION_MUSICA_project_DALTON.pdf.

MILESTONES TOWARDS 2050

	By 2021	By 2025	By 2030	By 2040
All	• Decarbonisation goals must be thoroughly socialized across ocean stakeholders, clear roles and action set for policy makers and significant increase in net zero commitment • Explore how all ocean-based activities could deliver co-benefits for nature and people • Integrate climate risk and resilience into COVID-19 recovery	• Strengthen and implement MSP • Increase ocean literacy and improve global understanding of ocean science • Increase resilience and adaptive capacity of coastal communities • Put in place information systems to manage downscaled knowledge on climate risks, vulnerability and impacts • Reform policies to adequately address direct or indirect stressors to coastal conservation • Continued to strengthened and revised NDCs including ocean-based climate solutions	• 100% of areas under national jurisdiction are sustainably managed • Targets of SDG14 are achieved. • All ocean based companies are on a net-zero pathway • Support measures to address the displacement of coastal and island populations because of climate change. • Ocean and coastal zones' ecosystem values and natural capital are anchored into policy and financial frameworks and decisions • Scientific knowledge has substantially increased and Ocean science is further progressing thanks to adequate funding and the outcomes of the United Nations Decade on Ecosystem Restoration (2021-2030), and the United Nations Decade on Ocean Science for Sustainable Development (2021-2030)	• The Ocean is 100% sustainably managed
Nature-Based Solutions	• Ocean NBS for mitigation and adaptation, including Blue Carbon Ecosystems, are incorporated into countries' revised NDCs • Include MPAs or other areas-based management tools in countries' climate strategies • Explore how all sectors could deliver co-benefits for ecosystems, biodiversity and society	• Strengthen and revise NDCs to include coastal and marine NBS to adaptation and mitigation • Reform policies to adequately address direct or indirect stressors to coastal conservation • Improved understanding of market and non-market financing options for blue carbon ecosystems	• 30% of fully and highly protected MPAs are designated, funded and implemented. • Global implementation of agro-climatic and disaster risk information systems, early warning systems, and adaptive climate and disaster risk governance	• 40% MPAs are designated, funded and implemented many of which are climate-smart MPAs • All activities in the Ocean are delivering co-benefits for ecosystems, biodiversity and society • 100% of the Blue Carbon Ecosystems are conserved and restored
Aquatic Food Production	• Strengthen and standardize methodologies for Life Cycle Emissions Assessment – including scope 3 and increase in net-zero commitment through Race to Zero • Establish policy to support climate risk proofing of grey infrastructure along the aquatic food value chain	• Mainstream aquatic food systems in NDCs, NAPs, sector/local adaptation plans • Promote climate-adaptive fisheries management and aquaculture development and develop tools applicable to data-limited and capacity-poor fisheries and aquaculture • Promote citizen science programmes to provide input to agro-climatic and disaster risk information systems	• Mainstream aquatic food systems in climate commitments and action, and upscale implementation of climate action (including NBS) • Fully integrate climate change into adaptive fisheries management and aquaculture development practices • Disseminate tools affordable to local communities for improved monitoring, climate preparedness and market access	• The aquaculture industry has grown significantly and produces food sustainably, contributing to low-carbon and healthy diets • Fully implement innovative feed solutions for aquaculture to minimize reliance on wild fish as feed ingredient • Fully integrate climate justice, equity and ethical considerations in decision making on allocation of and access to fisheries resources

		• Develop cutting-edge technologies to improve climate data in ABNJ, including climate variables that influence fish distributions		
Shipping	• Industry consensus on future zero carbon fuel mix • Tenfold increase in net zero commitments from ship owners and carriers compared to COP 25 through Race to Zero	• By 2023, IMO regulation in line with Paris targets • 10 industrial-scale zero carbon ship demonstration projects realized	• Global carbon price of USD50-100/ton of CO2 • Electrolysis cost USD1/kg Hydrogen • 5% zero-emission fuels in international shipping • 15% zero-emission fuels in domestic shipping • New and dynamic transportation routes - integrated into government ocean management plans – have been designed to minimize negative impacts on marine life.	• 80% zero emission fuels in international shipping • 90% zero emission fuels in domestic shipping
Ocean Renewable Energy	• Increase recognition of offshore wind in coastal states' NDCs • Define a S-Curve/Pathway to scale up offshore wind by 2050 and identify tipping points • Conduct rigorous, proactive and concerted environmental impact assessments	• Governments develop integrated ocean planning and allocate space for offshore wind • Floating offshore wind technologies are mature • Nature-Based Solutions are used to enhance biodiversity as part of the infrastructure maintenance	• Oil and gas companies are significantly investing in and operating offshore wind farms • Governments continue to develop integrated ocean planning and allocate space for offshore wind • Multi-use infrastructures are scaling up • New ocean renewable energies are entering the market (energy extracted from waves and tides) • Offshore wind farms are contributing to the restoration on marine ecosystems	• Ocean Renewable Energies are an important part of the global energy mix and continue to grow • Ocean renewables energies are producing co-benefits for marine ecosystems and biodiversity

PROGRESS

In addition to the progress presented below, it should be highlighted that there is **growing momentum, at the national government level, for the potential of the ocean** to help deliver on the most pressing challenges of our time. This includes the following two initiatives:

(1) At COP 25, Parties agreed to launch an official **Ocean and Climate Dialogue** under the auspices of the UNFCCC. The dialogue provided a space for Parties and non-Party stakeholders to discuss how to strengthen adaptation and mitigation action on oceans and climate change, drawing on the knowledge and scientific findings from the IPCC Special Report on the Ocean and Cryosphere in a Changing Climate;

(2) The **High Level Panel for a Sustainable Blue Economy (the Ocean Panel)** is an initiative of 14 world leaders who are building momentum for a sustainable ocean economy in which effective protection, sustainable production and equitable prosperity go hand-in-hand. The Ocean Panel has been working with governments, businesses, financial institutions, the science community and civil society to catalyse and scale up bold, pragmatic solutions across policy, governance, technology and finance to ultimately develop an action agenda for transitioning to a sustainable ocean economy.

1) Nature-Based Solutions

Ocean NBS can greatly contribute to climate change adaptation and mitigation. **Improving coastal resilience can have important co-benefits** such as protecting and restoring habitats, reducing pollution, creating jobs, supporting tourism and recreation, and providing financial resources to support conservation and climate action. Coastal resilience will also benefit coastal communities by achieving a human-centred approach, safeguarding the rights of the most vulnerable people and sharing the burdens and benefits of climate change and its impacts equitably and fairly.

A **current gap is the absence of a solid business case** for ocean NBS. Companies should simultaneously take action to reduce their GHG emissions as well as their impact on ocean ecosystems.

From a mitigation perspective, there is currently **increasing interest in NBS in the ocean for their potential to capture carbon**. However, it is important to recognize that NBS have only limited potential to mitigate climate change because the magnitude of anthropogenic GHG emissions is so large that the primary solution has to be reducing fossil fuel-related emissions to close to zero. Nature-Based Solutions can contribute to climate change mitigation **by compensating for hard-to-eliminate emissions**, but they cannot be viewed as a panacea to address climate change, in particular if they are promoted as an "offset" that permits business-as-usual, high-emission activities.[20] With a few exceptions, NBS tend to be project-based and limited in scope. It is therefore difficult to measure progress at a global level. In addition, more concrete, evidence-based targets are needed, in particular in nations holding a large percentage of the world's coastal blue carbon ecosystems. Some stakeholders are increasingly looking at the potential of seaweed (macroalgae) to capture and sink carbon. However, these potential solutions need more research and investment.

International initiatives such as the United Nations Decade on Ecosystem Restoration (2021–2030) and the United Nations Decade on Ocean Science for Sustainable Development (2021–2030) can help to provide data and information on required actions by each type of actor and how to implement these.

However, what is documented is that **coastal ecosystems are at risk**. The IPCC estimates that nearly half of all coastal ecosystems had been lost over the past century due to construction, drainage for agriculture, conversion to fish ponds and/or climate change. As much as 1 million hectares of coastal wetland ecosystems are still being lost annually according to the Blue Carbon Initiative.

2) Aquatic food systems

Global fish production continued to grow and reached 177.8 million tonnes in 2019, with 10 per cent of the world's population relying on the fisheries and aquaculture sector for their livelihoods, mostly small producers that need support. Aquaculture has been the fastest growing food production sector over the past five decades and has substantial potential to further grow and feed the world. Sustainable aquaculture development and prevention of aquatic diseases, antimicrobial resistance and environmental damage will be key to this growth. Sustainable fisheries can be more resilient to climate change, and recent findings (FAO, 2020a) show that efficiently managed fisheries have seen a reduction in fishing pressure and increases in stock biomass, with some reaching biologically sustainable levels.

In support of resilient sustainable fisheries following the guidance of United Nations Convention for the Law of the Sea (UNCLOS), countries sharing aquatic living resources cooperate in the form of regional fishery management organizations (RFMOs), in some cases covering many aquatic resources and extensive areas. RFMOs have consistently improved their performance over the past 15 years and as a result, many of these aquatic living resources have improved.

[20] Fries, L., Everett, J., and Davies, N. (EDS.) 2021. Transformational Opportunities for People, Ocean, and Planet. French Polynesia: Blue Climate Initiative, Tetiaroa Society. https://doi.org/10.5281/zenodo.4540323.

There is growing interest in the nexus between climate change and aquatic ecosystems as well as the food production systems they sustain. Although knowledge gaps are gradually being dealt with, the level of uncertainty with regard to climate change impacts on aquatic food systems remains high.

A significant milestone was achieved in 2021, when FAO member countries endorsed the Declaration for Sustainable Fisheries and Aquaculture at the 34th Session of the Committee on Fisheries. The Declaration explicitly calls for climate action in the sector and will reinforce the collective drive towards modern fisheries and aquaculture as part of inclusive, resilient and sustainable agri-food systems in pursuit of the 2030 Agenda.

The industry is also moving collectively by joining global initiatives such as Seafood Business for Ocean Stewardship (SeaBOS), which is a unique collaboration between scientists and seafood companies across the wild capture, aquaculture and feed production sectors. Together SeaBOS represents over 10 per cent of the global seafood production and comprises over 600 subsidiary companies globally.

The development of numerous eco-labeling initiatives and certifications across the globe contributed to the identification of sustainable practices for particular aquatic products and market incentives for sustainable production.

3) Shipping

For shipping, decarbonisation is starting to **gain momentum**, but increased ambition is needed across all industry stakeholders. With regard to policy, in 2018 the International Maritime Organization adopted a strategy to at least halve global emissions by 2050 and reach zero-carbon as soon as possible this century. An updated strategy will be developed by 2023. The European Union is planning to include shipping emissions in their Emissions Trading System by 2024.

If global initiatives are currently mobilizing stakeholders, there is an urgent **need for increased ambition from industry actors that is aligned with Paris Agreement targets and international and national regulations**. There is also an urgent need for the mobilization of governments, industry and finance to **fund the research and development and infrastructure** required to decarbonize shipping, with a short-term focus on realizing industrial-scale, zero-carbon ship demonstration projects by 2025.

More detailed information about progress to achieve zero-carbon shipping can be found in the Ocean and Coastal Zones Action Table and the Transport Action Table (page 45).

4) Ocean renewable energy

In 2005, there was less than 1 GW of offshore wind operating globally. This was mostly built close to the shore in Europe with projects generally less than 100 megawatts (MW) in size. In 2019 alone, 8 GW of new capacity was added, bringing the global total to over 30 GW. According to the World Bank, in 2015 an offshore wind project in Europe had a cost of energy of USD 150–200/MWh. In 2019, new projects were successful in auctions with a price equivalent to a cost of energy of below USD 60/MWh. **Cost reduction** has been achieved through continuous deployment, facilitation of innovation, learning, and investment in equipment and manufacturing, all driven by competition.

As the industry expands into new areas, new approaches, such as **floating foundations**, are being deployed. A truly global industry will support new turbine designs for low-wind sites or for withstanding tropical storms. Newer, larger designs will be developed that reduce overall capital cost, require less maintenance during long operating lives and lead to greater energy capture and capacity factors. Over the past 10 years, the average offshore wind turbine capacity has grown from 2 MW of capacity to over 12 MW, and 15 MW turbines are not far away. Turbine rotor diameters have grown from 60 metres to over 200 metres.

Wind farms have changed from tens of MW in size (e.g. North Hoyle Wind Farm, 60 MW in the United Kingdom's Irish Sea in 2003) to multiple GWs. The 1,200 MW Hornsea Project One in the North Sea was completed in 2020 and will power more than a million homes.[21]

Particular progress can be noted in Europe. First of all, the European Green Deal[22] emphasizes the key role offshore renewable energy will play in the transition to a climate-neutral economy, and the European Union Offshore Renewable Energy Strategy (2020)[23] confirms offshore renewable energy objectives.

In the European Union, the energy transition considerations also lead to the development of **innovative solutions** such as artificial energy islands or the repurposing of sea infrastructures to serve the energy transition by exploring how offshore wind farms can power nearby offshore oil platforms that turn demineralized water into hydrogen using electrolysis as part of hydrogen production.

[21] GWEC, Global Wind Report 2021.
[22] https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en.
[23] https://ec.europa.eu/energy/sites/ener/files/offshore_renewable_energy_strategy.pdf.

FACTS AND FIGURES

1) Ocean Nature-Based Solutions

- According to the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), the influence of human activities on marine ecosystems has expanded significantly in recent years. The IPBES assessment and other studies have found that marine habitats have changed in the following ways: Over 66 per cent of the ocean experienced increasing cumulative impacts in 2014 (up from 40 per cent in 2008);
    - Live coral cover on reefs has nearly halved since the 1870s, with the rate of decline most pronounced over the past two to three decades due to increased ocean acidification and water temperature (combined with other drivers of loss). Projections for coral reef loss are particularly dire: it is anticipated that a majority (70 to 99 per cent) of corals on Earth may die off in the coming decades due to rising temperatures;
    - Seagrass meadows decreased in extent by over 10 per cent per decade from 1970 to 2000;
    - Global coverage of mangroves has declined by roughly 40 per cent, while saltmarsh coverage has declined an estimated 60 per cent;
    - Kelp forests have shown significant declines in certain regions, including in the Great Southern Reef of Australia. Global patterns are more nuanced as kelp forests are declining in some areas but expanding in others.
- According to the Global Commission on Adaptation, protecting and restoring mangroves globally, at a cost of less than USD100 billion, could create USD1 trillion in net benefits by 2030.

2) Aquatic food systems

- Some 34.2 per cent of fish stocks are fished at biologically unsustainable levels. However, sustainability trends for many major species are improving. For example, catches of all kinds of tuna reached their highest level, about 7.9 million tonnes in 2018. Two thirds of these stocks are now fished at biologically sustainable levels. This is a sharp increase of 10 per cent in just two years, testament to intensive fisheries management in a sector marked by a high-value commodity and by significant overcapacity among some fleets (FAO, 2020a).
- Fish derived from sustainable fisheries and aquaculture is known to have one of the lowest carbon footprints among all food commodities (FAO, 2018a), providing more than 3.3 billion people with at least 20 per cent of their average per capita intake of animal protein (FAO, 2020a).
- Fish consumption globally is estimated to have more than doubled since the 1960s, from 9 kg per capita per year to 20.5 kg per capita per year, with the average annual increase in fish consumption outpacing that for all terrestrial animal-source foods (FAO, 2020a).

- Recent scientific research predicts that edible food from the sea could increase by 21–44 million tonnes by 2050, a 36–74 per cent increase compared to current yields. This represents 12–25 per cent of the estimated increase in all meat needed to feed 9.8 billion people by 2050 (Costello et al., 2020).
- Small-scale fisheries contribute about 50 per cent of global fish catches and employ more than 90% of people employed in fisheries. An estimated 97 per cent of all these fish workers live in developing countries, with many small-scale fishing communities experiencing high levels of poverty and being overlooked with regard both to resource management and from a broader social and economic development perspective (FAO, 2020a).

3) Shipping

More detailed data about zero-carbon shipping can be found in the Transport Action Table – p.45.

4) Ocean renewable energy

- In 2005, there was less than 1 GW of offshore wind operating globally. This was mostly built close to shore in Europe with projects generally less than 100 MW in size. In 2019 alone, 8 GW of new capacity was added to bring the global total to over 30 GW. According to the World Bank, in 2015 an offshore wind project in Europe had a cost of energy of USD150-200/MWh. In 2019, new projects were successful in auctions with a price equivalent to a cost of energy of below USD60/MWh.
- In 2020, offshore wind has delivered incredible global levelized cost of energy (LCOE) reduction of more than 67 per cent over the last eight years, according to Bloomberg New Energy Finance, and costs will decline by another third by 2030 (GWEC).
- The CAGR (Compound annual growth rate) for offshore wind in the next five year is 31.5 per cent. New installations are likely to quadruple by 2025 from 6.1 GW in 2020. In total, more than 70 GW offshore is expected to be added worldwide in 2021-2025 (GWEC).
- IRENA estimated that a 500 MW offshore wind project creates directly 2.1 million person days of work or about 10,000 person years over its life.

5) Ocean management

- Currently only 3.6 per cent of the ocean is in implemented MPAs, and only 2% is in implemented strongly or fully protected areas.[24]
- In 2020, around 70 countries have marine spatial planning strategies developed and/or implemented.

[24] Assessing real progress towards effective ocean protection – Enric Sala, Jane Lubchenco, Kirsten Grorud-Colvert, Catherine Novelli, Callum Roberts, Rashid Sumaila.

6) Ocean in National Determined Contributions

- In 2015, 28 countries' NDCs include a reference to coastal wetlands in terms of mitigation and 59 countries include coastal ecosystems and the coastal zone into their adaptation strategies.
- As of September 2020, 112 out of the 163 NDCs and six Intended NDCs referred to adaptation in the fisheries and aquaculture sector, including oceans and coastal zone management (FAO).
- Fewer than 20 per cent of countries with coastal blue carbon ecosystems, for example, discussed their role as carbon sinks (Ocean Conservancy).

KNOWLEDGE BASE – MAIN REFERENCES USED

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- The future of food from the sea (2020) – Costello et al. – Nature